MONTHLY WEATHER REVIEW,

DECEMBER, 1876.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In compiling the present Review, use has been made of all meteorological data received up to January 15th from the Voluntary Observers, Army Post and Signal Service Stations. The most prominent features in the meteorology of the month have been: 1st. The large number and very rapid movement of the areas of low pressure. 2nd. The low temperature which has averaged from 2° to 8° below the average for many years throughout the country east of the 100th meridian, as was anticipated in the Review for September: on the Pacific slope the month has been warmer than usual. 3rd. The absence of any area of very high pressure west of the Mississippi. 4th. The remarkable meteor of the 21st. 5th. The interesting solar halo of December 23rd. 6th. The absence of rain on the Pacific coast.

BAROMETRIC PRESSURE.

In General.—The distribution of average pressures for the month is shown by the isobars on Map No. II. The highest average is there located in the Lower Mississippi valley, with a nearly equal pressure in eastern Dakota. The lowest pressure is, as usual, over the Gulf of St. Lawrence. The isobar of 30.00 passes from Lake Superior southeastward to New Jersey. The average pressures at stations received since the map was printed are Virginia City, 29.75; Fort Sully, 30.17; Pembina, 30.16; Bismarck, 30.06.

Areas of High Barometer.—No. I.—On the morning of the 1st of December the pressure was 30.85 in Dakota, diminishing thence eastward to the Atlantic. On the morning of the 2nd the pressure had very generally diminished west of the Mississippi but increased to the eastward. The area of highest barometer extended from Minnesota southeastward to Louisiana, with temperatures of —5° and +25° in these two states respectively. On the morning of the 3rd the highest pressure continued to extend from Manitoba to the Gulf States, but gradients had generally diminished. On the morning of the 4th the pressure was highest in the Lower Missouri valley, and on the morning of the 5th in Louisiana and Mississippi, while low barometer No. I was central over Manitoba. The area of highest pressure now moved eastward and was, on the morning of the 6th, central in Alabama, and on the morning of the 7th in Georgia and Florida.

No. II.—This area appears on the morning of the 8th central in Texas, where it had apparently been formed by the flow of air from the northwestern portion of the State, in connection with the low barometer No. II that was then developing in the Lake region, and the falling pressure in the South Atlantic States. During the rest of December 8th the very general flow of cold air from the Northwest caused an extension of the area of high pressure over the whole country west of the Mississippi. The very severe storms known in local parlance as "Blizzards" were reported on the 8th as prevailing in Iowa and Wisconsin, where temperatures of —15° and —20° prevailed, with violent NW. winds and much drifting snow. On the morning of December 9th the highest pressure was central over Missouri, Illinois and Tennessee, whence it moved rapidly to the southeastward, being central over North Carolina on the morning of the 10th.

No. III.—The low pressure that prevailed on the 11th over the Lake region was, as usual, attended by rising barometer, extending from the Gulf northward over the Gulf States, where it was quite well-marked on the morning of the 12th. The central highest pressure was, however, by the morning of the 13th, transferred eastward to the South Atlantic coast.

No. IV.—The low pressure No. VII, over Lake Superior on the morning of the 14th, had, during its southeastward progress through British America, been followed by rising barometer on the Pacific coast. During the 13th, and on the morning of the 14th the pressure was highest in Dakota, with very steep gradients eastward over Minnesota and Lake Superior. This formed a small but well-defined area of high pressure, which moved rapidly southeastward, being on the morning of the 15th central in Arkansas, and at midnight of the 15th central in Louisiana.

No. V.—The rapidly rising barometer and very cold, high northerly winds in the rear of low barometer No. VIII, extended rapidly southward over the Northwest, where pressure was highest on the morning of the 16th, whence it extended eastward with unusual rapidity, and was on the morning of the 17th central in New York. This area of high pressure seems then to have taken a somewhat unusual course towards the northeast, being central over the Gulf of St. Lawrence on the morning of the 18th.

No. VI.—The low barometer No. IX was, during the 17th, followed by high pressure No. VI, which moved directly southward and was central on the morning of the 18th in Kansas, and on the morning of the 19th extended from Texas to Georgia, whence it spread over the Southern States, and was merged into the succeeding area.

No. VII.—was central on the morning of the 19th in Manitoba, whence it moved eastward, and was on the 20th, 7:35 a. m., central in Canada, and on the 21st, 7:35 a. m., central in Maine, after which it disappears.

No. VIII.—The slight depression No. XII, which was, on the morning of the 22nd, central in the Ohio valley, was followed by an extended southward flow of cold air over the Western plains, and the highest pressure was, at 7:35 a. m. of the 23rd, central in Dakota, whence it moved eastward over the Lakes, while low barometer No. XIII, developed in Texas and moved eastward along the Gulf coast. The highest pressure was, on the morning of the 25th, central in upper Canada, and on the 26th, 7:35 a. m., central in Maine.

No. IX.—The pressure remained pretty uniform on the 26th and 27th, but was, on the morning of the 28th, highest over the Upper Mississippi valley, Lake region and Middle States, while the severe storm-centre, No. XIV, was on the Louisiana coast. This storm was followed by an extensive area of high barometer, central in the Southwest, on the 29th and 30th, whence it moved northeastward, and was central in Tennessee on the morning of 31st, while storm No. XV, was advancing eastward over the Texas coast.

Areas of Low Barometer.—The areas of low barometer have been numerous, and have moved with unusual rapidity. The highest rate of progress has been that of No. X, being 59 miles hourly. The lowest, No. XIII, being 17 miles hourly. The average of all was 38 miles per hour. Of the fifteen tracks given on chart No. I, seven belong to the Lake region, four passed through Missouri or Illinois, three came from Texas and one belonged to the Atlantic ocean. In general this month has been considered very stormy and unpleasant, both on sea and land.

No. I.—This depression was in Manitoba on the morning of the 5th, having evidently moved southeastward along the slope of the Rocky Mountains, while the barometer had been rising at Portland, Oregon. On the afternoon of December 6th, 4:35 p. m., the depression was very extensive and central north of Lake Huron December 7th, 4:35 p. m., the depression was apparently central in New Brunswick, and followed by light snow over the Lower Lakes and New England.

No. II.—This depression first appears December 8th, 7:35 a. m., over Lake Superior, whither it had moved from the north or northwest. The barometer fell rapidly during the day over the eastern portion of the Lakes, but was rising rapidly over the western portion, with very low temperatures and northwest gales. By 7.35 a. m. of the 9th the area of lowest pressure, 29.10, extended as an elongated oval from Montreal to Boston, with very cold westerly gales over the Middle States and Lakes. Among the highest winds reported were: Cape May, SW., 72 miles; Grand Haven, W., 49; Erie, W., 48; Port Huron, W., 35; New York, W., 60; Sandy Hook, W., 84; New Haven, W., 40; Newport, SW., 60; Wood's Hole, NW., 50; Wilmington, NW., 29; Rochester, SW., 36; Oswego, NW., 36; Portland, Me., E. 38; Philadelphia, NW., 42; Marquette, NW., 54; Eastport, E., 43; Grand Haven, W., 49; Cape Lookout, W., 50; Barnegat, W., 45; Boston, W., 50. The depression continued moving eastward, and was, December 9th, 11 p. m., central over the Bay of Fundy, with the lowest pressure, 28.80.

No. III.—While No. II, was moving over New England depression No. III, was moving southeastward over Dakota, having evidently originated on the eastern slope of the Rocky Mountains, since the pressure at Portland, Oregon, had remained nearly stationary for several days. December 10th, 7:35 a. m., it was central in the Northwest, whence it moved southeast and eastward, and disappeared over Ohio during the day, being merged into the more extensive depression that followed.

No. IV.—This depression seems also, like No. III, to have rapidly advanced from the Northwest into Manitoba, where it rapidly developed on December 10th, between 4 p. m. and 11 p. m., and on the morning of the 11th was central north of Minnesota; during the rest of that day it extended southward over the

Lake region and Canada, where it was central on the morning of the 12th. During the rest of the day No. IV slowly disappeared during the advance of No. VI.

No. V.—This depression seems to have originated near Cape Hatteras during the 11th between the areas of N. E. winds that prevailed to the northward, and of S. W. winds that prevailed to the southward of this region. It was, on the morning of the 12th, apparently but a slight depression, but a severer storm may have prevailed to the eastward, whose nucleus was central near Halifax at 4:35 p. m., and near Cape Breton at 11 p. m., at which place the pressure had fallen to 29.02, showing that a severe storm was then under way.

No. VI.—This depression first appears in Montana and western Dakota on the morning of the 12th, whence it moved due eastward over the Upper Lakes into Canada, and thence northeast down the St. Lawrence valley, but is not traceable on the weather maps after 4:35 p. m. of the 13th.

No. VII.—This depression very closely followed No. VI, and may possibly be considered as its western portion. It was, 4:35 p. m. December 13th, central north of Minnesota, whence it moved southeastward to Lake Superior, followed by a very steep gradient. On the 14th it moved eastward along the northern limit of Canada, while brisk northwest winds, cloud and snow, prevailedover the Lakes; it was, on the morning of the 15th, central at the mouth of the St. Lawrence.

No. VIII.—Like four of the preceding areas, No. VII: descended from Manitoba southeastward to Lake Superior, where it was central on the morning of the 15th. It continued, during the day, moving southeastward to Lake Ontario, but at midnight turned northeastward, and at 7:35 a. m. of the 16th was central in northern Maine. Gales and high winds from southwest to northwest prevailed over the Lakes, St. Lawrence valley, Middle and Eastern States, on the 15th and 16th, while the central depression seems to have spread over the entire Gulf of St. Lawrence, where the storm was quite severe.

No. IX.—This depression originated in Kansas and northern Texas, over which region warm, southerly winds prevailed on the 16th; these winds, at 11 p. m. of the 16th, extended continuously northward to Montana and Manitoba, and were evidently due to the low barometer that prevailed at the Rocky Mountain and Pacific coast stations. Toward the same region of low barometer there also set in, after 11 p. m. of the 16th, strong north and east winds, which, on the morning of the 17th, prevailed from Kansas and Missouri northward, and were possibly in part a consequence of the precipitation in the form of light cloud and light rain or snow which had taken place before 7:35 a. m., December 17th, over the entire country west of the Mississippi; the depression moved rapidly eastward over the Ohio valley, and thence northeast along the western slope of the Alleghanies to New York, where it was central December 18th, 7:35 a. m., and whence it turned, during the day, abruptly eastward to Cape Cod. It was, at 11 p. m., central near Eastport, Me., the lowest barometer being 29.25, and with severe easterly gales at Halifax and Eastport. Its last location was in the morning, December 19th, near Prince Edward's Island, Gulf of St. Lawrence, with a central pressure of 29.00 or less, and severe storm throughout the neighboring region.

No. X.—This depression seems to have originated on the 18th between 7:35 a. m. and 4.35 p. m. The area of high barometer No. VI, which was then central in Kansas and Arkansas, appears to have supplied an abundant flow of air northward towards Nebraska, Iowa and central Minnesota. The temperatures in these States rose with unusual rapidity between the morning and afternoon observations, some of the changes in the nine hours being as follows: Cheyenne, 27°; Denver, 25°; North Platte, 48°; Fort Sully, 39°; Omaha, 33°; Leavenworth, 23°; Keokuk, 23°; La Crosse, 18°; St. Paul, 22°; Duluth, 18°. Equally decided was the southward flow of cold air from British America toward the same region, on the north side of which temperatures fell or remained stationary. It was in the region between these opposing winds and strongly contrasted temperatures that cloud and haze formed during the day and that the area of lowest pressure was rapidly developed as a trough stretching from southern Minnesota northeastward into British America. On the morning of the 19th this area was central in Canada, with branches extending far to the southeast and southwest, but its farther progress cannot be traced, as it seems to have become merged into No. IX, and the general depression then existing to the eastward.

No. XI.—On the 20th, 7:35 a. m., the low barometer that had apparently been developing in New Mexico during the previous night was central in Indian Territory, whence it moved northeastward, with light rains, in the Gulf States, and was dissipated during the day over the Ohio valley without having been accompanied by high winds at any of our stations.

No. XII.—This depression appears first in western Dakota at 11 p. m., of the 20th, while the temperatures had greatly fallen in Manitoba, with light northerly winds and clear weather. The central depression moved quite rapidly southeastward to Missouri, where it was central 11 p. m., 21st, preceded by extensive rains over the Southern States, thence its course was eastward to the New Jersey coast, which it reached on the 22nd, 11 p. m., accompanied by snow over the Lower Lakes, Middle and Eastern States, and

by high northeast to northwest winds on the Atlantic coast. It was last seen at 4:35 p. m., of the 23rd, east of Cape Breton, moving rapidly northeast.

No. XIII. - The moderate norther that followed low barometer No. XII seems to have been in great part induced by the low pressure prevailing from Texas to California on the 22nd, and to have given rise to the area of rain and subsequent low pressure, No. XIII, which was central on the western border of Texas at 4:35 p. m. of the 23rd. The barometric depression of the 22nd was evidently one of many similar cases in which an area of low barometer, existing upon the Pacific coast of Mexico, is transferred to the eastern slope of the Cordilleras precisely as occurs frequently along the coast from Alaska to Oregon. In both regions the consequences are similar - namely, a strong flow of air westward up the slope of the Rocky Mountains and the formation of areas of cloud, rain and snow with new centres of low pressure. The course pursued by No. XIII was slowly eastward along the Gulf coast to northern Florida, over which it disappeared 4:35 p. m. of the 25th, having been accompanied by heavy rains throughout the Gulf and South Atlantic States, and followed by a severe norther over the Western Gulf coast.

No. XIV.—This area seems to have originated in western Texas under conditions very similar to those attending the formation of No. XIII. It was central near the Texas coast at 11 p. m. of 22nd, whence it moved slowly eastward to the mouth of the Miss., and then turned to the northeastward through Ala. and W. Virg. into eastern New York, where it was central at 11 p. m of the 29th. The central low barometer had steadily and rapidly fallen from 29.80, at 11 p. m. of the 27th, and 29 65, at 11 p. m. of the 28th, to 28.85, at 11 p. m. of the 29th. At which time, also, the area of snow and rain, with high winds or gales, covered the Lower Lakes, Middle and Eastern States, making this one of the severe storms of a very stormy month. The depression continued its course northeastward on the 30th, and was, at midnight, central over the Gulf of St. Lawrence.

No XV.—While No. XIV was, during the evening of December 30th, passing over New Brunswick, and the highest pressure was central in the Eastern Gulf States, a third depression, No. XV, was developing in western Texas or northern Mexico, in consequence of the precipitation of moisture that had been carried by easterly winds up the slope of the Rocky Mountains. This depression was central at midnight of the 30th west of Indianola, but at 7:35 a. m. of the 31st was as a violent storm, central between Indianola and Galveston. It moved eastward during the rest of the 31st, with increasing severity, and was on the morning of January 1st, 1877, central in Georgia, while northerly gales prevailed in the Western Gulf. The track of this memorable storm, during the 1st and 2nd of January, is shown on chart No. I, but its further history belongs to the REVIEW for that month

Storms at Sea have been reported by numerous vessels, among them as follows: on the 1st heavy NW. gales off Cape Horn, also in lat. 44° N., long. 40° W.; hurricane in 37° N., 16° W.; on the 1st and 2nd, NW. gale off Cape Hatteras; on the 4th, heavy NW. gale, 30° N., 70 W., hurricane near the Orkney Islands; on the 7th, storm near Cape May; on the 8th, heavy W. gale off Cape Hatteras; on the 9th, furious NW. gale prevailed along the Middle and East Atlantic coast, increasing to a hurricane force in some localities; this gale was felt at sea as follows: on the Western Bank, also at 40° 15′ N., 67° W., at 43° N., 64° W., (a hurricane, ba. 28.80,) at 42° N., 61° W., at 40 N., 70 W.; on the 10th the gale of the preceeding day continued with high sea, being reported from 41° 44′ N., 59° W., 41 N., 56 W., 36° N., 70° W., and 40° N., 70° W.; on the 12th, a terrific gale in the Prince Edwards Islands; 13th, gale with high sea, 41° N., 62° W.; 14th, gale with high sea, 49° N., 37° W.; 15th, heavy gale and very high sea, 48° N., 37° W., also 41° N., 72° W; 16th, heavy N. E. gale veering to NW. on the Middle and East Atlantic coast; at St. John, N. B., the storm of the 16th and 17th was the severest of the season; wind gusts of 50 miles and heavy snow with great fall in temperature were reported; 18th, heavy gale and high sea, 46° N., 48° W.; 19th, heavy gale, 45° N., 53° W.; hurricane 34° N., 74 W., also a gale 34° N., 43 W., also heavy NW. gale off the Middle Atlantic coast; 24th, heavy NW. gale, 34° N., 74° W.; 26th, heavy NW. gale, 48° 17′ N., 34° 50′ W., also at 47° 31′ N., 37° 30′ W.; 29th, NE. gale veering to SW., 26° N., 71, W., also a heavy NE. gale veering to SW., and at times blowing with hurricane force 20 miles SE. of Abesecom, a cyclone was encountered between New York and Bermuda by the Bark Elila Brass; 30th, heavy SW. gale off Cape Fear river bar; 31st, heavy NE. gale and snow storm off the New Jersey coast.

TEMPERATURE OF THE AIR.

In General.—The general distribution of the temperature for the month is shown by the isotherms on Chart No. II. From which it appears that the temperatures have on the Pacific coast, been somewhat above the average. At the stations in the Rocky Mountains the deviations were: Salt Lake City, 3°; Cheyenne, 3°.9; Denver, 1°.7; Santa Fe, 2°.0; all below the average. East of the Rocky Mountains, and for altitudes less than 5,000 feet, the temperatures every where have been much below the average.

The Maximum Temperatures above 70° have been as follows: Corsicana, 72; Denison, 72; Galveston, 70; Indianola, 75; Jacksonville, 71; Key West, 87; Montgomery, 70; New Orleans, 72; San Diego, 77; Shreveport, 70; Berne, Texas, 71; and the maxima lower than 40° have been at Alpena, 38; Duluth, 39; Escanaba, 36; Marquette, 37; Pembina, 35; Pike's Peak, 27; Port Huron, 40. The maximum tem-

peratures for the month generally occurred from the 11th to the 14th, at most of the stations east of the Rocky Mountains, during the movement of storms No. IV, V, VI and VII.

Minimum Temperatures below —20° are as follows: Bismarck, —23°; Breckenridge, —23; Denver, —23; Duluth, —30; Fort Sully, —26; La Crosse, —24; North Platte, —25; Pembina, —49; Pike's Peak, —21; St. Paul, —27. The minimum above +20° have been Charleston, 23; Galveston, 26; Indianola, 23; Jacksonville, 24; Key West, 45; Mobile, 21; New Orleans, 28; Portland, Or., 24; San Diego, 43; San Francisco, 42; Savannah 20 and Tybee Island 25. The minimum temperatures have attended the progress of areas of high pressure and clear, dry weather, as given in the previous chapter. The principal epochs of low temperature have been as follows: 1st in Fla.; 2nd, Ga., S. C. and Fla.; 3rd, Fla.; 4th, Fla.; 6th, Ga., Fla.; 7th and 8th, Dak., Mo.; 9th, Ill, Ohio, Iowa, Minn., Ind., Tenn., Wis., Ky.; 10th, N. J., Md., N. C., Ohio, Mich., Pa., Va., W. Va., N. Y., D. C.; 11th, Cal.; 14th, Utah; 15th, Cal.; 16th, Mich., N. Y., Minn., Or.; 17th, N. Y., Mich., Mass., Vt., N. J., Me., Conn., R. I., Cal.; 18th, Utah, Cal.; 23rd, Cal., Montana, Tex.; 24th, Wy. T., Col., N. M.; 25th, N. Y., Wy. T., Tex., Mass.; 26th, Dak., Kan., Neb.; 27th, Dak.; 28th, Col.; 29th, Dak., Tex., Kan., Neb.; 30th, Minn., Ill., Dak., Ind. T., Tenn., Ga., Ala., Miss., La., Neb.; 31st, Tenn.

Ranges of Temperature.—The largest ranges of temperatures for the month have been: Denver, 93°; North Platte, 87°; Dodge City and Pembina, 84°; Fort Sully, 82°; Fort Gibson, 77°; Breckenridge, 75°; Yankton, 72°; Leavenworth and Duluth, 69°; St. Paul, 68°; Bismarck, Denison, Keokuk, La Crosse and Virginia City, 67°. The smallest ranges have been: San Francisco, 22°; Portland, Or. and Salt Lake City, 32°; San Diego, 34°; Tybee Island, 38°; Buffalo, Charleston, Key West and New Orleans, 42°; Cape Lookout, Sandy Hook and Smithville, 43°; Atlantic City, Barnegat and Galveston, 44°.

Frosts have occurred as far southward as the Gulf States in every day of the month except the following: 8th, 11th, 14th, 21st, 22nd, 23rd and 24th. The first period of cold, which continued from the 1st to the 6th, is especially reported on by the Observer at Punta Rassa, according to whom, at that place, scarcely anything escaped being injured by the cold. Large quantities of fish, of all sizes and kinds, were killed by the cold water, and cast up on the beach daily. Snow fell for about five minutes on the morning of the 1st. Within a region of fifty miles radius frost occurred nearly every day.

PRECIPITATION.

In General.—The distribution of the total amount of rain or melted snow for December is shown upon chart No. III. The great irregularity in snow-fall and its drifting by the wind, as well as the want of uniformity in methods of measuring the dry and the melted snow render the isohyetal lines, open to some doubt; but, in general, it appears that less than an inch fell in Minn., Iowa, Ill., and westward to the Rocky Mountains, producing a large deficiency in this region as compared with normal values. The deficiency is also quite decided in the Ohio valley and Tennessee and for the Middle Atlantic States. A small deficiency is reported from the Upper and Lower Lake regions, Minnesota, New England and the Western Gulf States, but a large excess has fallen in the Eastern Gulf and South Atlantic States. The deficiency in New England and the Middle Atlantic States was to a large extent made up for by the storm of January 1st, 1877. The most remarkable feature of the map is the remarkable deficiency in Or. and Cal. The normal values for these regions are approximately as follows: San Diego, 2 inches, San Francisco, 5 inches and Portland, Or., 7 inches. These notable deficiencies are to be taken in connection with the high temperature and the high barometric pressures that have also prevailed there.

Stations reporting no rain during month.—No rain at all is reported from four stations in the immediate neighborhood of San Francisco, Cal., as also from Ft. Clarke, on the Rio Grande, Texas. Numerous stations report one-tenth inch of rain, or less, near the boundary between Kansas and Nebraska.

Stations reporting heavy rains or snow are as follows: Cape Lookout, 6.15; Jacksonville, 6.15; Mobile, 7.18; New Orleans, 9.57; St. Marks, 8.51; Baton Rouge, 2 inches of rain fell from noon to 10 p. m. of the 31st. *Heavy snows* were reported as follows: Monticello, Ark., 28th, 7 inches; 31st, 21 inches; Lenore, N. C., 24th and 25th, 11 inches; Spartanburg, S. C., 23rd, 24th and 25th, 10 inches; McMinnville, Tenn., 28th and 29th, 14 inches, heaviest snow ever known; Raleigh, N. C., 25th, 13 inches, heaviest snow storm ever known in that vicinity; Memphis, Tenn., 28th, 8½ inches; Shelbyville, Tenn., 28th, the heaviest snow-fall since the 15th and 16th of May, 1843, when the fall was 21 inches, and very uniform. The observer at Hiwassie College, Tenn., reports that the snow-fall of December 31st and January 1st amounted, in 17 hours, to 20 inches, being the most remarkable snow-fall known to the inhabitants.

Total snow-fall for month.—Ark., 12 to 28 inches; Conn., 11 to 38; Col., 4; Dakota, 5; Del., 4½; Ga., 1; Ill., 2 to 26; Ind., 3 to 24; Iowa, 2 to 8; Kan., 1 to 7; Ky., 10 to 14; La., 12; Maine, 32 to 43; Md., 8 to 15; Mass., 12 to 36; Mich., 15 to 24; Mo., 1 to 4; Neb., 1 to 5½; N. H., 39 to 42; N. J., 6 to 18; N. Y., 7 to 10; N. C., 6 to 26; Ohio, 8 to 42; Penn., 4 to 28; R. I., 18; Tenn., 17 to 29; Tex., 8; Utah, 10; Vt., 18 to 55; Va., 4 to 18; W. Va., 28; Wis., 3 to 21.

Rainy Days.—The number of days, during the month, on which some rain or snow fell is as follows: Alpena, 27; Buffalo, 26; Cleveland, 25; Detroit, 21; Erie, 25; Grand Haven, 22; Morgantown, 21; Oswego, 25; Pittsburgh, 22; Port Huron, 27; Rochester, 27; Toledo, 21—from which it will be seen that in the Lake region the precipitation has been remarkably frequent. The number of days on which precipitation has occurred in the remaining districts is as follows: New England, 9 to 18; Middle Atlantic States, 6 to 14; South Atlantic States, 9 to 13; Gulf States, 6 to 18; Ohio valley and Tennessee, 5 to 15; Northwest, 3 to 17; Rocky Mountain stations, 5 to 11.

Cloudy Days.—The number of days on which the cloudiness has equalled eight on a scale of ten, as reported by voluntary observers, ranges as follows: New England, 6 to 25; Middle States, 4 to 25; South Atlantic States, 4 to 13; Gulf States, 5 to 17; Ohio valley and Tennessee, 6 to 20; Upper Lake region, 15 to 22; Northwest, 1 to 13.

Drouths.—A scarcity of water is reported from some portions of the Middle States, New England and the Northwest, owing to the continued cold weather, which has prevented the snow from melting. The lack of rain in California has caused some apprehensions on the part of farmers that agricultural interests may suffer.

RELATIVE HUMIDITY.

The mean relative humidity for the month, as reported from the Signal Service stations, ranges as follows: in New England, 69 to 78 per cent.; Middle Atlantic States, 66 to 80; South Atlantic States, 62 to 74; Gulf States, 57 to 74; Indian Territory, Arkansas and Tennessee, 55 to 72; Lower Lake region, 72 to 80; Upper Lake region, 61 to 79; Ohio valley and Northwest, 64 to 74; Cheyenne, 66; Denver, 51; Pike's Peak, 65; Santa Fe, 46; Virginia City, 62; Salt Lake City, 89; Portland, Or., 82; San Francisco, 66; San Diego, 58. The unusually moist atmosphere at Salt Lake City was accompanied by a dense fog, which hung over the station almost continually from the 5th until the 20th.

WINDS.

Prevailing winds.—These are shown by the arrows on chart No. II. They have very generally been from N., NW. or W. over the entire country from the Rocky Mountains eastward to the Atlantic, except in Tennessee and the Ohio valley, where they have been more variable.

Total movement of the air.—The following are the largest total movements of the air as recorded at the Signal Service stations: Pike's Peak, 19,641 miles; Cape May, 16,407; Sandy Hook, 14,954; Thatcher's Island, 13,669; Kitty Hawk, 12,166; Cape Lookout, 11,737; Barnegat, 11,445; Erie, 11,289; Grand Haven, 10,209; Wood's Hole, 10,168. The smallest movements have occurred at the following stations: Salt Lake City, 1,636 miles; Nashville, 2,648; Virginia City, 2,684; Portland, Or., 2,727; Dubuque, 2,854; San Diego, 3,079; San Francisco, 3,115; Shreveport, 3,326.

Highest Winds.—Among the highest hourly wind velocities reported from Signal Service stations are the following: Boston, 29th, E. 57; Buffalo, 15th, W. 60; Bismarck, — 64; Cape May, 9th, W. 72, 17th, NW. 60; Eastport, 18th, SE. 54, 29th, E. 69; Erie, 16th, W. 52; Grand Haven, 15th, SW. 66; Knoxville, 8th, SW. 54; Malone, 15th, S. 52; Marquette, 9th, W. 54; Milwaukee, 15th, W. 54; Morgantown, 8th, W. 54; New York, 9th, W. 60, 16th, NW. 60; Newport, 9th, SW. 60; Pembina, 15th, NW. 54; Pike's Peak, 7th, — 66, 29th, — 90; Sandy Hook, 9th, W. 84, 16th, NW. 63, 18th, NW. 60, 30th, W. 68; Thatcher's Island, 29th, E. 60. The observer at Detroit reports that during the storm of the 15th and 16th, in which the wind attained a maximum velocity of 35 miles per hour from the W., the changes in pressure and temperature were unprecedented in respect to magnitude and rapidity. A fall in pressure of .20 of an inch was recorded in two hours, followed by a rise of .86 in eight hours. The temperature rose 17° in eight hours and subsequently fell 32° in the same interval. The approach of this storm was fully anticipated by the Cautionary Signals. The high winds accompanying low barometer No. V, appear to have been very severe in Newfoundland. According to reports from St. Johns falling barometer and gales continued throughout the 13th, the barometer falling to 28.60 at 9 a. m. A *water-spout* was observed at Wilmington, N. C., on the 29th, at 8 a. m. At Augusta, Ill., a violent *whirlwind* occurred on the 8th, at 9 a. m.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily weather indications with the telegraphic reports for the succeeding 24 hours shows a percentage of verifications of 88.1 and a percentage of omissions of 0.9 in detail. The percentages have been as follows: for weather, 95.2; wind, 86.6; temperature, 85.6; barometer, 85.0. The geographical distribution of the verifications has been as follows: New Eng. 88.9; Mid. States, 90.2; S. Atlantic, 90.4; E. Gulf States, 89.0; W. Gulf States, 87.8; Lower Lake region, 89.3; Up. Lake region, 88.1; Tenn. and the Ohio valley, 90.0; Up. Miss. valley, 85.1; Lower Mo. valley, 80.2.

Cautionary Signals.—There have been displayed during the month at U. S. S. stations 192 cautionary storm signals; of these 142 were verified at the stations, and 19 others, or 83 per cent. in all, verified within

a hundred miles of the stations. Thirty were not justified. Seventy-four cases are reported in which signals were needed but not displayed.

NAVIGATION.

Height of rivers.—The highest and lowest readings on the Signal Service river-gauges are given in the table on chart No. III. From which it appears that the Red river at Shreveport and the Miss. from Cairo to New Orleans were highest during the first ten days of the month and lowest at its close. At Cairo the lowest reading of the month was on the 30th, when the river was only three inches above the low watermark of December, 1861. In the Ohio and tributaries the lowest waters occurred about the middle of the month.

Ice in rivers is reported as follows: *Mississippi river*—Davenport, closed 2nd, men crossed 4th, teams 10th. St. Louis, navigation interrupted 2d, river gorged 4th, navigation resumed 7th, suspended 9th, river frozen over 11th. Cairo, navigation suspended to points above on the 2nd, and to points below 23d. Keokuk, closed 16th. Nashville, ice in river 19th, 20th, 30th and 31st. Memphis, river gorged 30th. La Crosse, ice averages 19 inches in thickness, and some was cut 31 inches thick, on the 31st. *Missouri river*—At Lower Brule Agency, closed 1st. Leavenworth, frozen at shore during month, and after the 20th channel closed. Plattsmouth, Neb., closed 3d. St. Joseph, Mo., ice bridge 5th. *Ohio river*—Cincinnati, navigation closed 9th, and river frozen over 10th. Laconia, Ind., full of floating ice 9th. Louisville., Kentucky, navigation suspended 9th, river gorged 15th. Pittsburg, frozen over 10th. Portsmouth, Ohio, gorged 10th.

For other places the following notes have been received: On the 1st, Albany, N. Y., Erie canal closed; Lyndon, Ill., Rock river closed; Logansport, Ind., Wabash and Eel rivers frozen over; Alpena, Mich., Thunder Bay river frozen over (and harbor frozen 8th); Chicago, Ill., navigation closed. 2nd, Monticello, Iowa, Maynoketa river frozen over; Trenton, N. J., Delaware and Raritan canal frozen over; Cincinnati, Miami canal closed. 3rd, Shelburne, N. H., Androscoggin crossed by pedestrians (and on 10th by teams). 4th, Trenton, N. J., Delaware river frozen over. 5th, New Geneva, Pa., on account of ice boats stopped running. 6th, Buffalo, N. Y., navigation closed. 8th, Decatur, Ill., Sangamon river frozen over. 9th, Philadelphia, Pa., Schuylkill and Delaware rivers frozen over (ice gorges in Delaware 17th and 27th); Morgantown, W. Va., Monongahela river frozen over; Knoxville, Tenn., Holston river closed 9th (first time in thirteen years). 10th, Bloomfield, Wis., Geneva lake frozen over; Bangor, Me. and Erie, Pa., navigation closed. 12th, Washington, D. C., Potomac closed. 15th, Salem, N. J., Salem creek closed (ice 10 in. thick 31st); Detroit, Mich., navigation closed (ice in river 4th to 12th, gorged 12th). 16th, Grand Haven, Mich., navigation closed. 17th, Cooperstown, N. Y., Otsego lake closed; Port Huron, Mich., Black river frozen, and an ice bridge across the St. Clair. 18th, Asheville, N. C., the French Broad river was crossed on ice by cattle, &c., for several days about this date. This is the first time that this has ever occurred within the knowledge of the observer. 19th, Fall River, Mass., Taunton river and Narragansett bay frozen over. 20th, West Point, N. Y., large masses of floating ice; Wappinger's Falls, N. Y., navigation on Hudson ceased. 25th, Standish, Me., Sebago lake frozen; has not been known to freeze *with the water so low* since 1838.

TEMPERATURE OF WATER.

The maximum and minimum temperatures at the bottom of the water are given in the table on chart No. II. The highest maxima are: Charleston, 53°; Jacksonville, 54°; Mobile, 55°; St. Marks, 50°; Punta Rossa, 72°; Key West, 84°, which unusually high temperature was observed on the 24th. The lowest maxima are: 32°, Omaha; 33°, St. Louis and Milwaukee; 34°, Grand Haven and Marquette, 36°, Chicago, Duluth and Knoxville.

Minimum water temperatures.—The lowest are: 28°, New York; 29°, Escanaba; 30°, Portland, Me., Wood's Hole; 31°, Baltimore and Memphis. The highest minima are: 54°, St. Marks; 52°, Punta Rossa; 45°, Key West, Jacksonville and Mobile; 43°, Charleston; 41°, Savannah.

Ranges of water temperatures.—The largest ranges of water temperature during the month are the following: Key West, 39°; Punta Rossa and Baltimore, 14°; Springfield, Norfolk and Wilmington, 11°; Augusta, Charleston, Mobile, New York and New London, 10°. Smallest ranges: Omaha, 0°; St. Louis, 1°; Knoxville and Duluth, 3°; Keokuk and San Francisco, 4°.

Ocean temperatures.—December 28th, bark Speranza, in lat. 38° 19′ N., 71° 10′ W., found the temperature of the water 68°, after two hours, 75°, and one hour subsequently 76°. All at once found the water riffling with a very heavy swell, and supposed it to be the boundary of the Gulf stream, as six miles in a NW. direction found the water only 55°.

ATMOSPHERIC ELECTRICITY.

Thunder and lightning-storms have occurred as follows: 8th and 9th, New London, Conn. 17th, Galveston, Texas; Pt. Pleasant, La. 18th, Newport, R. I.; New London and Mystic, Conn.; Dover, Del.; New Orleans, La.; Mendon, Billerica, Westboro', Fall River, Waltham and Boston, Mass.; Brookhaven, Miss.; Vineland, N. J. 28th, Galveston, Texas; Wilsonville, Ala. 31st, Indianola and Austin, Texas.

Auroras were observed as follows: 4th, Yankton, Dak. 10th, Boston, Quincy, and Somerset, Mass.

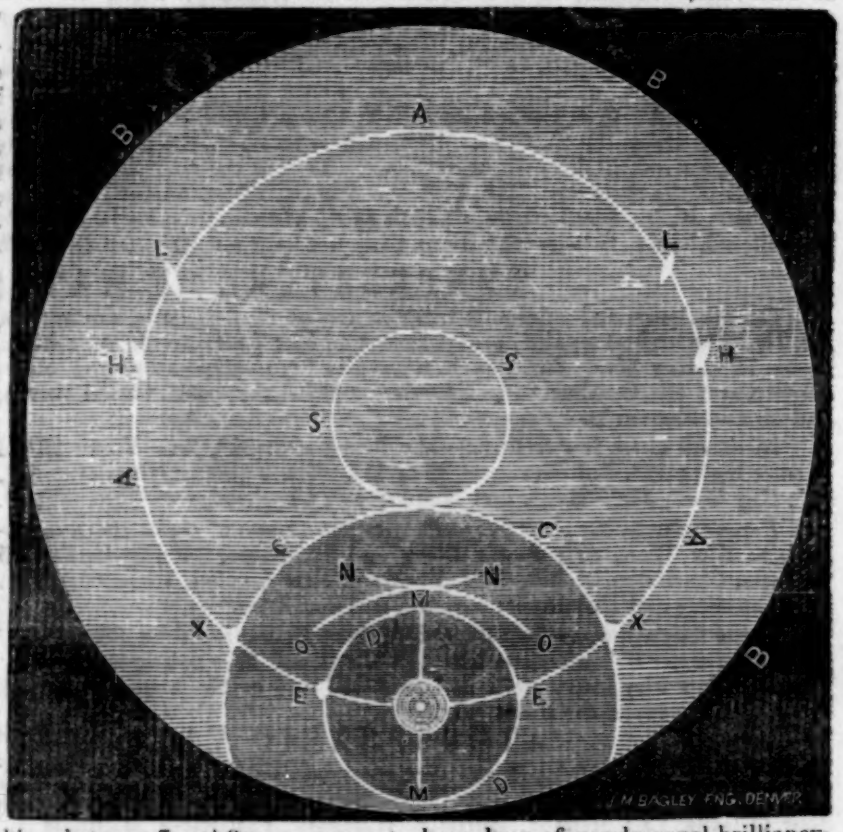
Duluth, Minn.; Cresco, Iowa; Cornish and Gardiner, Me.; Newport, Vt.; Waupaca, Wis. 11th, La Crosse, Wis.; Cresco, Iowa; Gardiner, Me. 13th, Eastport, Me. 16th, Dodge City, Kan. 17th, Duluth, Minn.; Malone, N. Y.; Gardner, Me. 18th, Austin, Texas. 19th, Auburn, N. H. 21st, Escanaba, Mich. 23d, Egypt, Penn. At Attaway Hill, N. C., from 10 p. m. of the 22d to sunrise of the 23d, a peculiar reddish glow was observed in the northeast. At Carthagena, Ohio, shortly after the passage of the great meteor, on the evening of the 21st, the observer noticed a reddish glow in the northeast which lasted a few minutes.

Telegraphic Ground Currents.—The observer at Detroit reports that, in connection with the great storm of the 16th, the operators of the Western Union Telegraph Company worked the lines without a battery, during a portion of the night of the 15th and 16th. At this time clear weather, low temperature and northwest gales prevailed immediately west of Detroit, while southwesterly winds, warmer, cloudy and snowy weather prevailed to the eastward.

OPTICAL PHENOMENA.

Solar Halos were noted as follows: 1st, Ill., Mich., N. Y., Wis. 2nd, Del., Iowa, Me., N. Y. 3rd, Me., N. H. 4th, Ill., D. C., Tenn. 5th, Miss., N. Y. Texas. 6th, Iowa, Neb., Tenn. 7th, Ill., Ind., Ky., Mass., N. Y., Ohio, Tenn. 8th, Dak., Ind., N. Y., Ohio, Penn. 9th, Ill., Ind., Iowa, Kan., Ky., Mich., Ohio, Penn., Tenn. 10th, Dak., Mich., Minn., N. H., N. Y., Penn. 11th. N. Y. 12th, Minn., N. Y., 13th, N. H., N. Y., Ohio, Tenn. 14th, Ind. Ty., Iowa, Minn., N. J., N. Y. Ohio. 15th, Miss. 16th. Ill., Ind., Iowa, Mass., Tenn., Wis. 17th, Dak., Md., N. Y., Wis. 18th, Minn., Tenn., Wis. 19th, Minn., Neb., Ohio, Penn., Tenn. 20th, Ill., Iowa, Mass., Ohio. 21st. Ill., Iowa, Mich., N. Y., Ohio, S. C. 22nd, Kan., Texas, Wis. 23rd, Col., Iowa, Minn., Neb., N. J., Wis., Wy. 24th, Dak., Ill., Kan., Mich., Minn., N. J., N. Y. 25th, N. H., N. Y. 26th, Iowa., Kan., Neb. 27th, Iowa, Kan., Minn., Neb. 28th, Dak., Mass., Neb., N. H., N. Y., Penn., Wis. 29th, Iowa, Mo., Neb. 30th, Ill., Iowa, Minn. 31st, Minn.

A very interesting solar halo was observed at Denver, during the 23d, it consisted essentially of two concentric circles, (DD and CC,) surrounding the sun of 22° and 46° radii respectively; two other concentric circles, (SS and AA,) around the zenith whose radii varied with the altitude of the sun, but were at midday respectively about 15° and 60°, (SS and CC were tangent to each other;) there were also segments (OO and NN) of circles, centered respectively at the sun and zenith and tangent to each other, these circles had the same radii, namely, about 30°; there was also a well defined vertical column (MM) extending through the sun as a diameter to the circle (CC.) At the intersections of all these circles the mock suns or sun dogs were seen, and also at other points (L, L, H, H) to the number of eight in all. The whole display steadily increased in brilliancy, from sunrise until 9:40 a. m.; it continued at its maximum brilliancy until 11:50 a. m., and was still beautiful at 2 p. m. That portion of the zenithal circle (SS) which lay nearest the sun, was a strikingly brilliant rain-bow, the red being nearest the sun, and all its glowing colors were very clearly defined. The spectacle was the admiration of the entire population. The solar halo observed on the 10th, at Pembina, between 7 and 9 a. m., seems to have been of nearly equal brilliancy. The circles (DD, CC and AA) and the rainbow segment of (SS) and the vertical column, (MM) and four of the attending mock suns were well seen.



Lunar Halos were noted as follows: 1st, Ala., Dak., D. C., Iowa, Me., Md., Mich., N. J., N. Y., Ohio, 2nd, Ala., Conn., D. C., Ill., Ind., Iowa, Md., Minn., N. H., N. J., N. Y., N. C., Ohio, R. I., Tenn., Wis. 3rd, Iowa, Me., N. C., Tenn. 4th, Cal., Del., Me., N. J., Ohio. 5th, D. C., Tenn., Wis. 7th, D. C., Fla., Ill., Ind., Neb., Ohio, Vt. 8th, D. C. 9th, Ohio. 10th, D. C. 12th, N. J. 14th. Minn. 19th, Dak., Ind. 20th, Ga., Kan., Mo., N, J., N. Y., W. Va., Va. 21st, Fla. Ill., Iowa, Kan., Me., N. Y., N. C., Ohio. 22nd. Ala., Ark., Ga., Iowa, Kann., Miss., Neb., Ohio, Tenn., Texas, Wis. 23rd, Conn., Dak., Del., D. C., Iowa, Md., Mass., Minn., Neb., N. J., Ohio, Penn., Utah, Va. 24th, Conn., Dak., Iowa, Mass., Mich., Minn., N. J., N. Y., R. I., Texas. 25th, Ind., Minn., Neb., Wy. 26th, Col., Iowa, Md., Neb., Texas, Va. 27th, Col., Del., D. C., Iowa, Md., Neb., N. J., N. C., Penn., Tenn., Va., Wis. 28th, Dak., D. C., Ind., Iowa, Me., Mass., Neb., N. H., N. J., N. Y., R. I., Vt., Wis. 29th, Col., Dak., Ind., Iowa, Kan., Mich., Neb., Tenn. 30th, Al., Ill., Ind., Iowa, Kan., Me., Mass., Minn., Neb., N. Y., Penn., Tenn., Wis. 31st, Ga., Ill., Ind., Iowa, Minn., Mich., N. Y., Ohio, Penn., Tenn., W. Va.

Mirage.—3rd, Breckenridge, Minn. 4th, 26th and 27th, Great Bend, Kan. 11th and 13th, Tybee Island, Ga.

MISCELLANEOUS PHENOMENA.

Polar Bands were observed as follows: 1st, Breckenridge, Minn. 4th, Detroit, Mich.; Duluth, Minn. 5th, Duluth, Minn.; Dubuque, Iowa. 6th, Iowa City, Iowa; Carthagena, Ohio; Plattsmouth, Neb. 7th, Guttenburg, Iowa. 8th, Auburn, N. H. 10th, Eastport Me. 11th, Tybee Island, Ga. 13th, Carthagena, Ohio; Wytheville, Va. 14th, Danville, Ky.; Carthagena, Ohio. 15th, Freehold, N. J.; Carthagena, Ohio. 16th, Tabor, Iowa; Carthagena, Ohio. 17th, Gardiner, Me. 19th, Dubuque, Iowa. 21st, Danville, Ky.; Wytheville, Va.; Tybee Island, Ga. 22nd, Iowa City, Iowa. 23rd, Danville, Ky.; Carthagena, Ohio. 25th, Gardiner, Me. 27th, Wytheville, Va. 28th, Iowa City, Iowa; Auburn, N. H. 29th, Iowa City, Iowa. 30th, Iowa City, Iowa. 31st, Wytheville, Va.; Tybee Island, Ga.

Zoological.—*Wild geese* were seen, at Nashville, flying S. 17th; St. Louis, Mo., N. 21st; Laconia, Ind., S. and SE. 20th and 21st; Creswell, Kan., NE. 7th; Fall River Mass., SW. 8th. *Wild ducks* were seen at Laconia, Ind., flying S. and SE. 20th and 21st. *Swans* were seen at Baltimore, Md., 4th. *Crows* were seen, at Baltimore, Md., flying S. 30th and 31st.

Prairie fires.—4th, Pike's Peak; 6th and 8th, Creswell, Kan.; 12th, Fort Gibson, Ind. Ty.; 13th, Fort Randall, Dak,; 15th and 18th, Oregon, Mo.

Zodiacal Light.—8th, Oregon, Mo.; 13th, 14th, 16th and 18th, Bellfontaine, Ohio; 16th, Nashville, Tenn.

Earthquake.—A slight shock was felt in the west end of the city of Charleston on the evening of the 12th, windows rattled and the usual evidences of such convulsions were plainly felt. Wytheville, Va, an earthquake shock, 10:30 a. m., 21st, is reported.

Meteors.—1st, Penn., Texas. 2nd, Texas. 4th, Ill., Ohio 5th, N. J., Penn. 6th, Ill., N. Y., Penn. 7th, Iowa, Md., N. Y. 8th, Ky., Mich. 9th, Md. 10th, Ill., Iowa, Mo. 11th, Iowa, Kan., Mo. 12th, Ga., Mo., W. Va., Wis. 13th, Iowa, Mo. 14th, N. C., Ohio. 15th, Kan., N. Y., Vt. 16th, D. C. 17th, Cal. 18th, Ill., N. C., Texas. 19th, Texas. 20th, Kan. 21st, Ill., Ind., Iowa, Kann., Minn., Mo., Neb., Ohio, W. Va. 22nd, Kan. 24th, Texas. 30th, Penn. 31st, Fla., Texas.

The great meteor of the evening of the 21st was one of the most remarkable that has lately been recorded in the United States; reports concerning it have been received from about 120 stations. From a brief study of these it becomes apparent that the meteor entered the earth's atmosphere somewhere over or west of Kansas or Nebraska, its true course was nearly due east, and it was last seen over the State of New York. Its visible track, as projected upon the earth, is therefore over a thousand miles long. The times of its appearance and disappearance, as noted by the observers, are extremely discordant. The average of about 45 observations, pretty uniformly distributed along its course, gives 9h. 26min. as the Washington mean time, which may, therefore, represent the moment when it was at the middle of its visible path. No definite conclusion can be satisfactorily arrived at, with reference to its actual velocity in miles, from a comparison of the records of distant observers; but the observations of the individual observers, taken by themselves, give velocities relative to the earth's surface of between 1 and 5 miles per second, or 2 to 5 miles relative to the earth's centre, and as the meteor was overtaking the earth in its annual orbit, its velocity in space relative to the sun was 20 to 25 miles, its movement being towards a point in lat. 20°, long. 35°, with reference to the plane of ecliptic. When first seen the meteor appeared to be as large as the moon, but much brighter. In passing over Indiana its main body divided into two portions, and one of these subsequently broke into a hundred fragments, which at first kept together in one cluster, but gradually fell behind each other, forming a long train in single-file and as such passed over Ohio into New York. The brightness of the meteor was everywhere described as far surpassing bright moonlight. No reliable accounts speak of any noise heard during the visibility of the meteor, but in from two to five minutes after its passage a shock resembling thunder was heard, which in the majority of cases was described as tremend-

ous, shaking the ground and the houses, and was especially alarming to those who, on account of the prevailing cloudiness, were unable to see the preceding meteor. The uniform character of the sound heard at all stations shows that it was not due to any violent explosion, (properly so-called,) but was a peculiar acoustic phenomena, depending on the fact that that portion of the line described by the meteor when nearest to any observer, became, as it were instantaneously along a length of several miles, the origin of a series of simultaneous sounds which, although in themselves comparatively feeble, were concentrated into a violent sound when they reached the observer's ear. No records have came to hand of the finding of any fragments of this meteor, nor is it likely that any of any size fell to the earth, as the main body evidently passed out of the atmosphere when over New York, and the smaller fragments or sparks that were seen to fly off were rapidly burned up and disappeared in its train.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

Brig. Gen. (Bvt. Asst.) Chief Signal Officer, U. S. A.

Copy furnished for